

# THE NEW HIGH PRESSURE CELL FOR THE HP-XPS INSTRUMENT ON THE MAX II AND MAX IV SPECIES BEAMLINE



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## Abstract

A new high pressure cell, designed to be operated in the HP-XPS instrument installed on the new SPECIES beamline of the MAX II (and later MAX IV) electron storage ring in Lund, Sweden, is presented. In the new high pressure cell, a sample can be investigated in situ at gas pressures up to 10 mbar or more with a new 0.3 mm nozzle.

A new gas delivery system, based on a double cone solution, ensures that fresh, non reacted gas reaches the sample on the same spot hit by the incoming synchrotron light. The light enters the cell through an aluminum foil window, while the electrons escape to the analyzer through a 0.3 mm nozzle situated some millimeters in front of the sample. The sample can be loaded into the high pressure cell directly from the UHV manipulator, without breaking vacuum, or it can be installed in the cell in the ambient atmosphere, and then be brought to the experiment atmosphere without passing from UHV.

The sample can be heated up to 1200 K in the high pressure cell. A quadrupole mass spectrometer (for masses up to 200 u) is connected to both to the inlet and outlet of the high pressure cell via leak valves for monitoring the inlet gas and reaction product compositions.

## New features

### A smaller gas volume:

it is faster to fill, easier to measure.

### The double cone gas delivery system:

fresh, non reacted gas is delivered on the sample center, the same spot hit by the beam.

### Closer pressure reading:

a micro Pirani gauge is located at approximately 20 mm from the sample.

### Button heater heating:

the back of the sample carrying plate is in direct contact with a noble metal filament heater.

### A pure aluminum window:

the light transmission is increased by using a non coated aluminum membrane, guaranteed to be pinhole free.

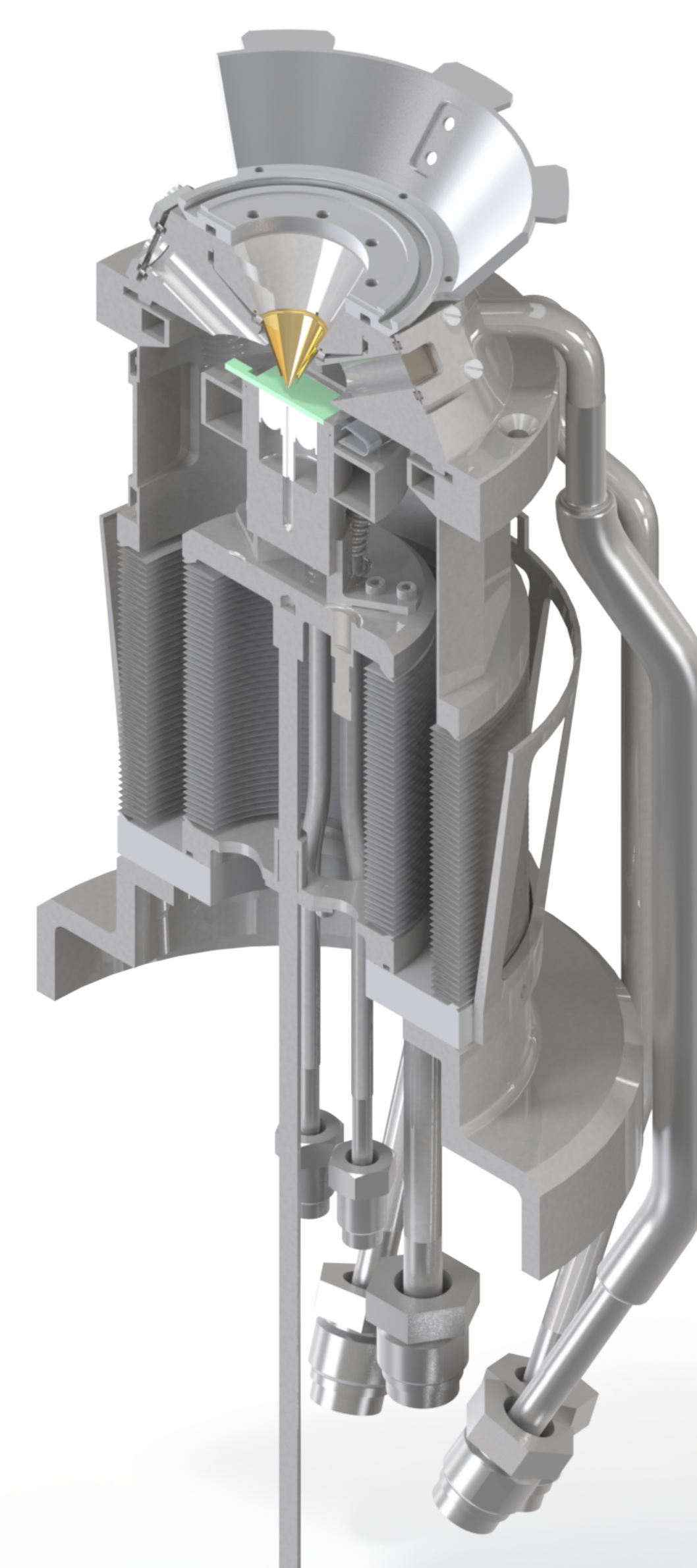
### A more compact design:

dimensions are reduced to make the mounting easier.

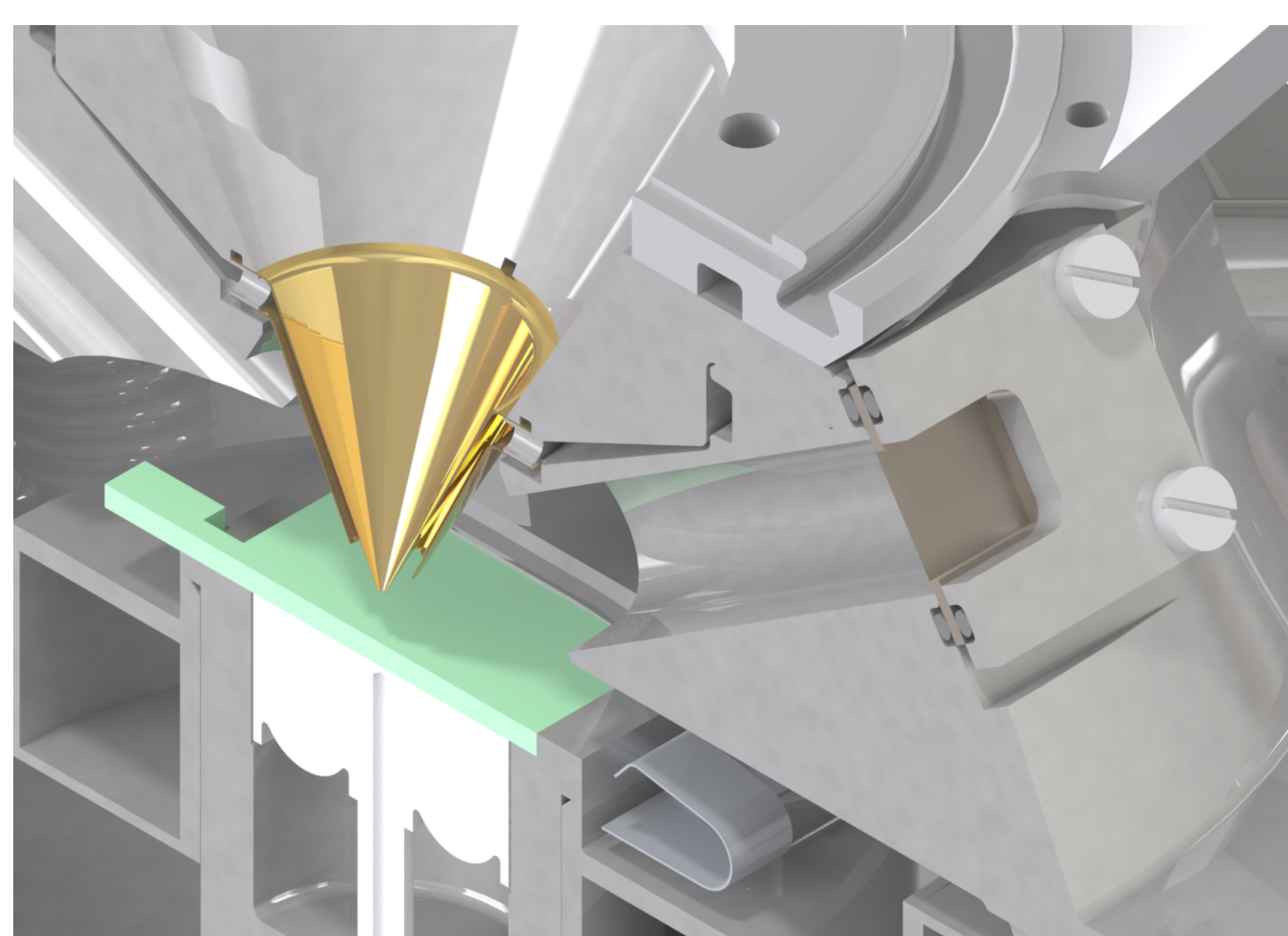
### Integrated cooling:

both the skimmers and the sample can be gas cooled, for faster sample unloading.

## The new high pressure cell in pictures



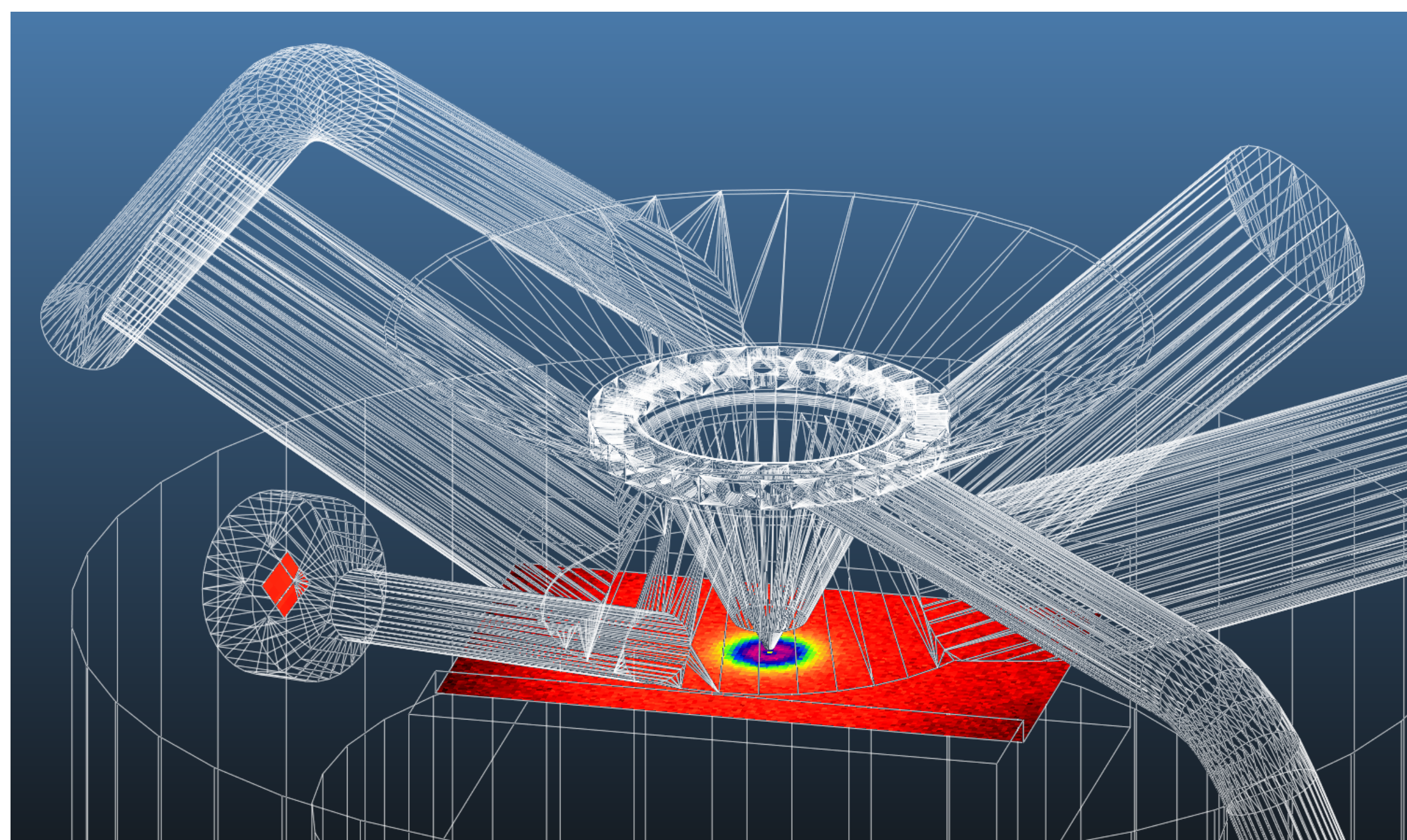
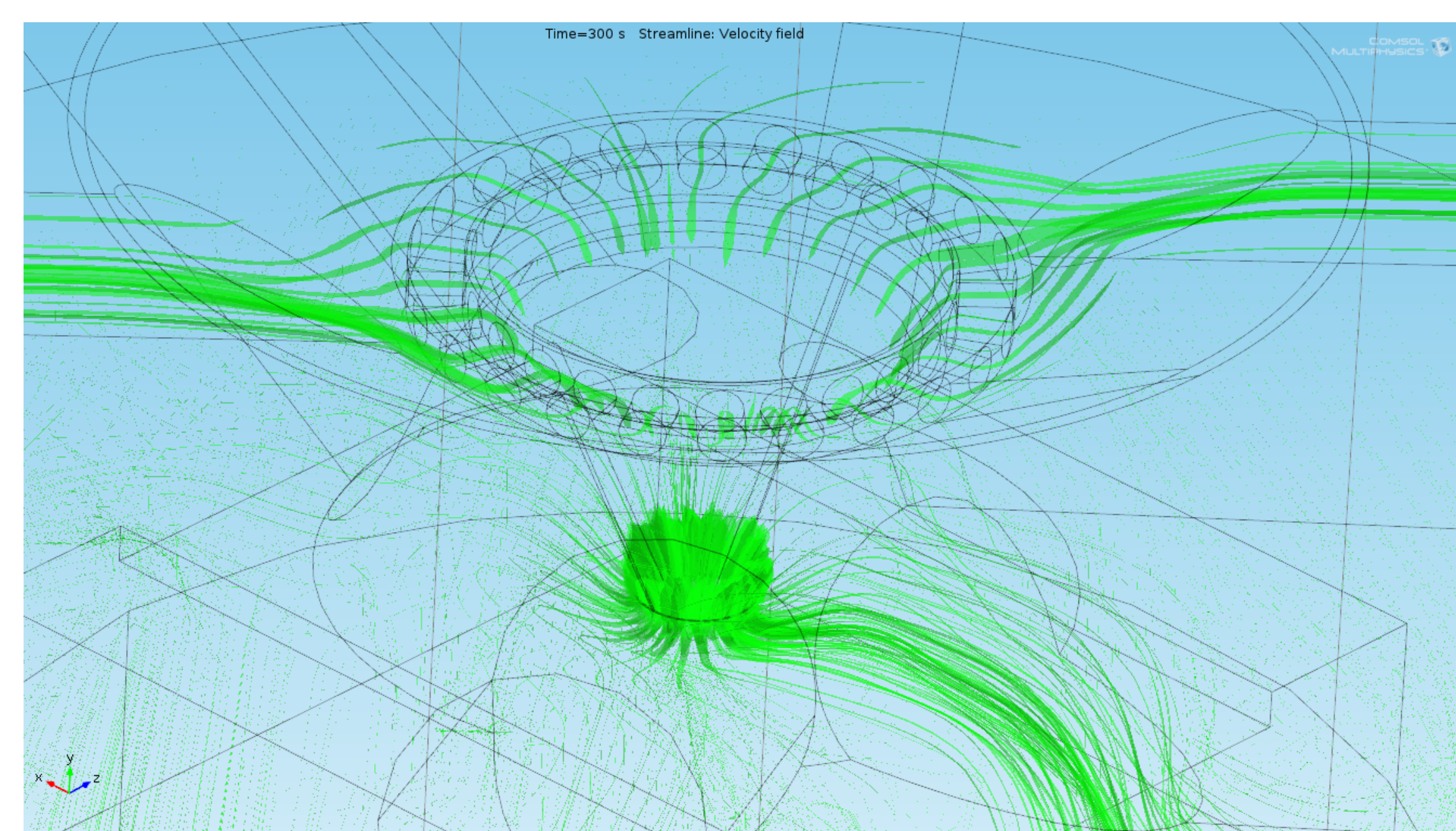
## Two skimmers to deliver gas in the sample center



The pressure range allowed by the cell is wide enough to require several different approaches for the gas flow simulations.

Close to the maximum pressure in fact the gas is expected to behave according to the Navier-Stokes equations, while at really low pressures a molecular flow model could be necessary to represent correctly the most narrow passages.

The laminar flow simulation (on the right) shows that the incoming gas reaches the sample on the center, giving a pressure peak in the same spot hit by the beam. This configuration allows the reaction to happen with fresh, non reacted gas, in the spot under investigation.



The free molecular flow simulation also shows a peak of hits close to the sample center, validating this design independently of the final gas regime.

In this case however the ratio between the high pressure points and the low pressure ones is as low as 4, with benefits also for the accuracy of the pressure reading provided by the near micro Pirani sensor (the small red square on the far left).

